FOUR NEW SPECIES AND A NEW GENUS OF THE FAMILY GASTROPTERIDAE FROM JAPAN (GASTROPODA : OPISTHOBRANCHIA)

AUTHOR(S):

Tokioka, Takasi; Baba, Kikutaro

FOUR NEW SPECIES AND A NEW GENUS OF THE FAMILY GASTROPTERIDAE FROM JAPAN (GASTROPODA : OPISTHOBRANCHIA)[1)]

TAKASI TOKIOKA
Seto Marine Biological Laboratory, Sirahama
and
KIKUTARÔ BABA
Biological Laboratory, Osaka Gakugei University, Osaka

With Plates X-XIII and 15 Text-figures

Recently the first author had a chance to examine a small collection of special opisthobranchs that was made by His Majesty the Emperor of Japan in Sagami Bay and sent to him for identification. Even after a long meandering consideration, the identification was still suspended around a few genera of Cephalaspidea. Especially all the specimens appeared to conform exactly to *Gastropteron* in every character of the genus excepting that they had no shell. However, it was informed that these specimens were fixed in BOUIN's solution. Then it is very possible that their shells were decalcified and extremely softened, or dissolved in the fixative that no piece of solid shell might be found in any of these preserved specimens. Or, it is very probable, too, that there occur some species of the genus without shell as this structure shows a tendency of intensive degeneration in already known members of this genus. Thus after all, this collection was concluded as of *Gastropteron*. Very fortunately the collection was accompanied with precise colour illustrations of live specimens made by the members of the Biological Laboratory of the Imperial Household. These must be of a conclusive significance when the final identification is made on respective forms. Being helped by Dr. T. KURODA, the first author studied references about *Gastropteron* as far as he was allowed to get access and learned that the collection might include three new species, *G. japonicum*, *G. viride* and *Sagaminopteron ornatum* to be described later. The first author sent then the material to the last author for examination of jaws and radulae and asked him for taxonomical advices. The last

1) Contributions from the Seto Marine Biological Laboratory, No. 421.

author opened the mouth parts exactly and found that two of the three forms beared the radulae of the usual type of *Gastropteron*, while the other, *Sagaminopteron ornatum*, had the radula of a quite different type. Besides, he noticed another form of *Gastropteron*, *G. flavum* to be mentioned later, in the collection of opisthobranchs which was also obtained by His Majesty in Sagami Bay and submitted to him for identification. Four specimens of this form were sent to the first author for the study of external morphology after its mouth part was examined. Moreover, the last author found, among his own unpublished data, some sketches of two forms referable respectively to *G. flavum* and *Sagaminopteron ornatum*. Thus, the occurrences of four new species of Gastropteridae were recognized in the Japanese waters, and one of which might represent a new genus.

Also the last author presented some more references of this animal group, among which was found the comment made by Mme PRUVOT-FOL in "Faune de France" (1954, pp. 46-48) that the family Gastropteridae comprises two genera, of which one is exotic. To settle the exact situation of the possible new genus in the present material, it was urged to refer to the actual account of the above-mentioned "exotic" genus. The effort made chiefly by the last author was not successful. Fortunately, however, his endeavour was rewarded kindly by Mme PRUVOT-FOL who, answering the inquiry made by him, mentions in her letter of July 11, 1964 written during her sojourn in Switzerland—"In New Caledonia, I have myself found a very small animal, shaped as a *Gastropteron*, probably a young one—it was certainly not the same animal as that which you have drawn in your letter; I think this is entirely new, even generically, as you say……." Thus, the establishment of the following four new species and a new genus was confirmed by both authors.

1. *Gastropteron japonicum* n. sp.
2. *Gastropteron flavum* n. sp.
3. *Gastropteron viride* n. sp.
4. *Sagaminopteron ornatum* n. g., n. sp.

The following descriptions are mainly based upon the specimens collected by His Majesty in Sagami Bay, but partly supplemented by data gathered by the last author on specimens from some other localities. Both authors wish to express here their hearty thanks for the great privilege conceded by His Majesty to them to study these precious specimens. They are very grateful, too, to Dr. T. KURODA for his generous help and advices which enabled them to open the gate to the present study, and also to Prof. S. M. SHIINO and Mr. M. GHISELIN for lending or sending them important references and to Mme A. PRUVOT-FOL for giving them that kind information about the description appeared in "Faune de France."

REVIEW OF THE PREVIOUSLY DESCRIBED SPECIES OF *GASTROPTERON*

So far as both authors are concerned, apart from the synonyms of *Gastropteron rubrum*, there are five described species of *Gastropteron*.

1. *Gastropteron rubrum* (RAFINESQUE, 1814)*
   =*G. coccineum* FÉRUSSAC, 1822
   =*G. meckeli* BLAINVILLE, 1825
   =*Clio amati* DELLE CHIAJE, 1823
2. *Gastropteron sinense* A. ADAMS, 1861
3. *Gastropteron pacificum* BERGH, 1893
4. *Gastropteron sibogae* BERGH, 1905
5. *Gastropteron cinereum* DALL, 1925

Of these, *G. rubrum* has been described repeatedly and fully and *G. pacificum* and *G. sibogae* are accompanied with detailed descriptions, while other two, *G. sinense* and *G. cinereum*, are described so briefly that it is hardly possible to make an accurate comparison at the level of species between these and some or any of other species. This is much more pronounced in the case of *G. sinense*. Rather, it may be reasonable to reproduce here the original descriptions of these two species and leave the judgement about the specific validity of these two forms to respective readers. Only it it possible that *G. cinereum* is related closely to *G. pacificum* (and thus to *G. japonicum* n. sp.) as mentioned already by DALL himself, as it is devoid of any mantle protuberance on the roundish dorsal hump, and its tail is comparatively much smaller than in any other species else than *G. pacificum* and *G. japonicum* n. sp, as shown in the original figures. And so far, indistinctness of the creeping sole and the flesh-coloured body covered wholly with crimson punctate and reticulate markings are all of the available characters of *G. sinense*.

1. *Gastropteron rubrum* (RAFINESQUE)

Main references: VAYSSIÈRE 1885, pp. 40–43, Pl. 2, figs. 35–41—*G. meckelii*; BERGH 1893, pp. 284–303, Taf. 16, figs. 1–27, Taf. 17, figs. 1–10—*G. meckeli*; PILSBRY 1895, pp. 40–41, Pl. 7, figs. 1–10, Pl. 8, figs. 11–13, 16—*G. rubrum*.

This is the best known species distributed mainly in the Mediterranean Sea and on the Atlantic coast of France, to about 120 m deep. It is said to occur also in the western Atlantic (Florida, West Indies and Brazil).

The body attains 18–33 mm long and 35–42 mm wide when measured on expanded parapodia, and the tail is 12–13 mm in length. The ctenidium bears more than a dozen leaflets, they may be up to 25–30. As one of the distinctions of this species, the free mantle margin is provided posteriorly with a

* Synonymy after FISCHER (1890), PILSBRY (1895) and others.

finger-like flagellum. The sole is not so clearly marked off from the parapodia. The embryonal shell is microscopic, nautiloid with $1\frac{1}{2}-2$ whorls, calcareous and very hyaline. Paired jaw-plates formed of rodlets. Radular formula $20\text{–}40\times5\ (-6).\ 1.\ 0.\ 1.\ 5\ (-6)$, the first lateral being provided with a finely denticulated inner edge.

The body colour appears to be variable: it is from red purple, orange red to pale rose often studded with bluish white flecks, and there is an iridescent blue or white border on the edges of the cephalic shield and parapodia. The sole is paler.

2. *Gastropteron pacificum* BERGH

References: BERGH 1893, pp. 303–306, Taf. 16, fig. 28, Taf. 17, figs. 10–26—*G. pacificum*; BERGH 1894, pp. 202–205, Taf. 12, figs. 1–2—*G. pacificum*; DALL 1921, p. 64—*G. pacificum*.

Thirteen specimens were collected from Unalaschka of the Aleutian Islands to Fuca Strait, 9–15 fathoms, in August 1874. General appearance of the body resembles somewhat that of *G. rubrum*, 7.5 mm long and 12 mm wide when measured on expanded parapodia. The free mantle margin is narrow, only behind a little wider, and without any flagellum. The sole is clearly defined from the parapodia. The tail is short. The ctenidium bears 16–20 leaflets. Nephridial aperture near to the anus is coloured black. The embryonal shell resembles that of *G. rubrum* and 0.6–0.66 mm in diameter. With paired jaw-plates. Radular formula $20\text{–}22\times5\ (-6).\ 1.\ 0.\ 1.\ 5\ (-6)$; teeth shaped as in *G. rubrum*, the first lateral bearing 12–20 denticles.

The living animal is said to be yellowish with red flecks. In the preserved state, the cephalic shield, sole and parapodia are seen yellowish with numerous red dots which are more or less grouped closely, more closely set on the underside of the body as well as on the posterior free edge of the cephalic shield. The dorsal hump is grayish and sometimes, especially in its anterior portion, sprinkled with reddish dots. The ctenidium is whitish.

3. *Gastropteron sibogae* BERGH

Reference: BERGH 1905, pp. 32–34, Taf. 9, figs. 14–17—*G. sibogae*.

Nine preserved specimens, 10–26 mm in length, from Paternoster Island, Sailus Besar in the Siboga Area. The body-form is said to be as in other species. There is a contracted flagellum on the mantle. The ctenidium consists of 20–22 leaflets and is entirely free in the distal one-third. The nephridial aperture is open above the anal papilla and sometimes marked by a grayish pigmentation. The anterior half of the HANCOCK's organ is found just below the anterior margin of the cephalic shield; it is oval, yellowish, depressed along the middle and furnished with transverse striations especially richly along the margins. The posterior half of the organ reaches the posterior

base of the shield and is marked with yellowish narrower or wider striations. The pedal gland is on the median line of the tail. With brownish yellow jaw-plates. Radular formula 22–27×5. 1. 0. 1. 5. The first lateral appears to be especially characterized by having no denticulations. The shell is devoid of calcified spire.

The colour in the preserved state is whitish throughout, the anterior edge of the cephalic shield, HANCOCK's organ and ctenidium are yellow or yellowish and the anal papilla is gray.

The four individuals from the same locality were coloured throughout bluish black so darkly that no parts of viscera were seen through and thus they were separated from the typical forms as var. *nigra*.

4. *Gastropteron sinense* A. ADAMS

This is the only species of *Gastropteron* ever recorded from the sea just adjacent to Japan. Very unfortunately, it is imperfectly known. But, in order to get something for recognizing the species, the whole original description is to be traced below:

ADAMS, A. (1861): On some new species of Mollusca from the north of China and Japan. Ann. Mag. Nat. Hist., Ser. 3, Vol. 8, pp. 139–140.

Gasteropteron sinense A. ADAMS

G. animali carneocolore, ubique carmineo punctatim et reticulatim picto, corpore pallidiore, integumento subpellucido visceribus conspicuis; pedis lobis magnis, liberis, marginibus integris, rotundatis, superficie rubro punctata ac reticulata.

Hab. Hulu-Shan Bay (Regent's Sword); 3 fathoms (mud).

I obtained three individuals of this species in the dredge from three fathoms mud. I placed them in a clear bottle of salt water, and observed them some time. CHIAJE might well be excused for regarding the genus as a Pteropod, for at first sight it has all the appearance and action of a Pneumodermon. My specimens appeared to want the power of crawling altogether; the animals, after taking short flights, usually upside down, through the water, by butterfly-flappings of the side-lobes of the foot, gently alighted and remained stationary on their stomachs, with the swimming-lobes folded together over the back, until ready for another little excursion. The lower surface of this species, moreover, is coloured exactly like the fins, and shows no signs of a creeping disk. I believe the genus should be placed in the family *Lophocercidae*, or, rather, *Icaridae*; for Prof. E. FORBES had previously described *Lophocercus* under the name of *Icarus*. The Chinese species seems to differ from the Mediterranean *Gasteropteron* in being covered with crimson punctate and reticulate markings. Other points of difference are shown in my drawings.

(But, actually no drawing is presented for this species.)

5. *Gastropteron cinereum* DALL

Here the full citation is made again of the original description of this poorly known species.

DALL, W. H. (1925): The Pteropoda collected by the Canadian Arctic Expedition 1913-18, with description of a new species from the North Pacific. Canadian Arctic Expedition 1913-18, Vol. 8, Pt. B, pp. 11-12, fig. 4.

Gastropteron (*pacificum* BERGH var. ?) *cinereum* DALL, n. sp.

1. Skidegate inlet, Queen Charlotte islands, British Columbia, July, 1910, W. SPREADBOROUGH, collector. Victoria Memorial Museum, Mollusks, No. 3177 ; cotype, presented to United States National Museum.
2. West side of Vancouver island, Ucluelet, British Columbia at low tide, C. H. YOUNG and W. SPREADBOROUGH, May, 1919. Cotype, Victoria Memorial Museum, Ottawa, Cat. Mollusks, No. 3176. (Fig. 4).

Both the North Atlantic, Asiatic, and North Pacific species of *Gastropteron* are of a reddish colour sprinkled densely with darker red dots. The present form is of a uniform dusky slate colour and of a smaller size than the Pacific species described by BERGH. It is an interesting addition to the sparse list of known species. The spread of the parapodia totals 10 to 15 mm., the length of the body 8 to 11 mm. (in spirits), in the living state it was probably larger. The anterior shield is about one-third the whole length of the body. Like *G. pacificum*, it lacks a posterior flagellum on the mantle.

DESCRIPTIONS OF NEW SPECIES

1. *Gastropteron japonicum* n. sp.

(Japanese name: *Yamato-umikotyô*)

(Text-figs. 1-4, Pl. X fig. 9, Pl. XI figs. 1-5, Pl. XIII figs. 1-2)

Holotype : Biological Laboratory of the Imperial Household, Sp. No. 1219-A, collected off Kurosaki in Sagami Bay, 110-120 m, on July 24, 1963.

Paratypes : No. 1—Biological Laboratory of the Imperial Household, Sp. No. 1219-B, collected together with the holotype.
No. 2—Biological Laboratory of the Imperial Household, Sp. No. 1218, collected off Kurosaki in Sagami Bay, 110 m, on July 21, 1963.
No. 3—Biological Laboratory of the Imperial Household, Sp. No. 1221, collected off Zyôgasima in Sagami Bay, 300 m, on March 13, 1964.

Four specimens were examined by the authors. The holotype, paratypes No. 1 and No. 3 are kept in alcohol, while the paratype No. 2 is preserved in formalin which is made very mucid by the secretion of the animal. The holotype is the largest, 10 mm long and 15 mm wide across the expanded parapodia; the paratypes are respectively 7.5 mm long×12 mm wide (No. 1),

7 mm long×11 mm wide (No. 2) and 5 mm long×7.4 mm wide (No. 3). Parapodia are large, slightly wider than the dorsal hump, roundish in outline, and broadest at the level near the middle. In the holotype, the head region is fully extended anteriorly and prominently protruded out beyond the frontal level of the parapodia (Pl. XI fig. 1), while in the paratypes the head region is strongly contracted and little protruded out (Pl. XI fig. 4). The dorsal hump

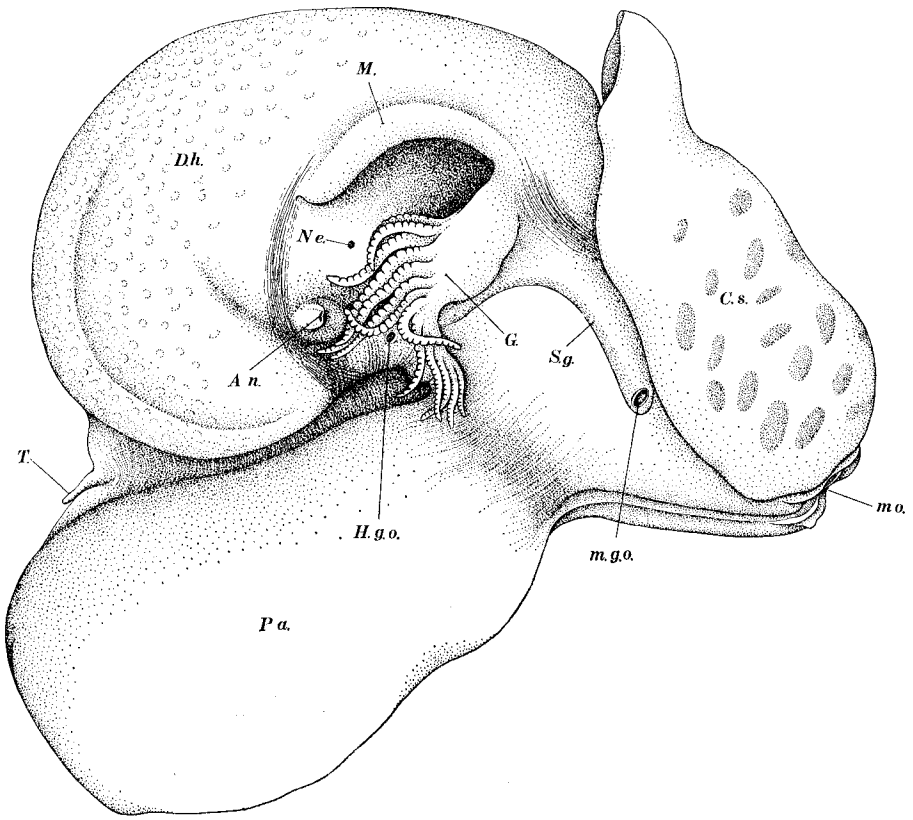


Fig. 1. *Gastropteron japonicum* n. sp. Right side of holotype, ×10.
For abbreviations see p. 224.

is very large, ovoid, longer than wide and smooth on the surface. There are scattered a number of small groups of whitish cells over the hump and these may look like a sort of minute papillae when the specimens are illuminated from some direction. The integument is translucent and vessels and light purplish brown or orange brown viscera are seen through (Text-fig. 2). The cephalic shield is large, only a little shorter than the dorsal hump. The posterior half of the shield is narrowed conspicuously (Text-fig. 4 A), with

lateral edges somewhat incurled to form a sort of funnel, and the distal end is rounded. As the dorso-median crest (*m. c.*) of the head region does not extend onto the inner surface of the cephalic shield (Text-fig. 4 C), the posterior half of the shield is entirely free and flexible, and may be folded at fixation as shown in Text-fig. 4 B. The sole is well defined all around with distinct

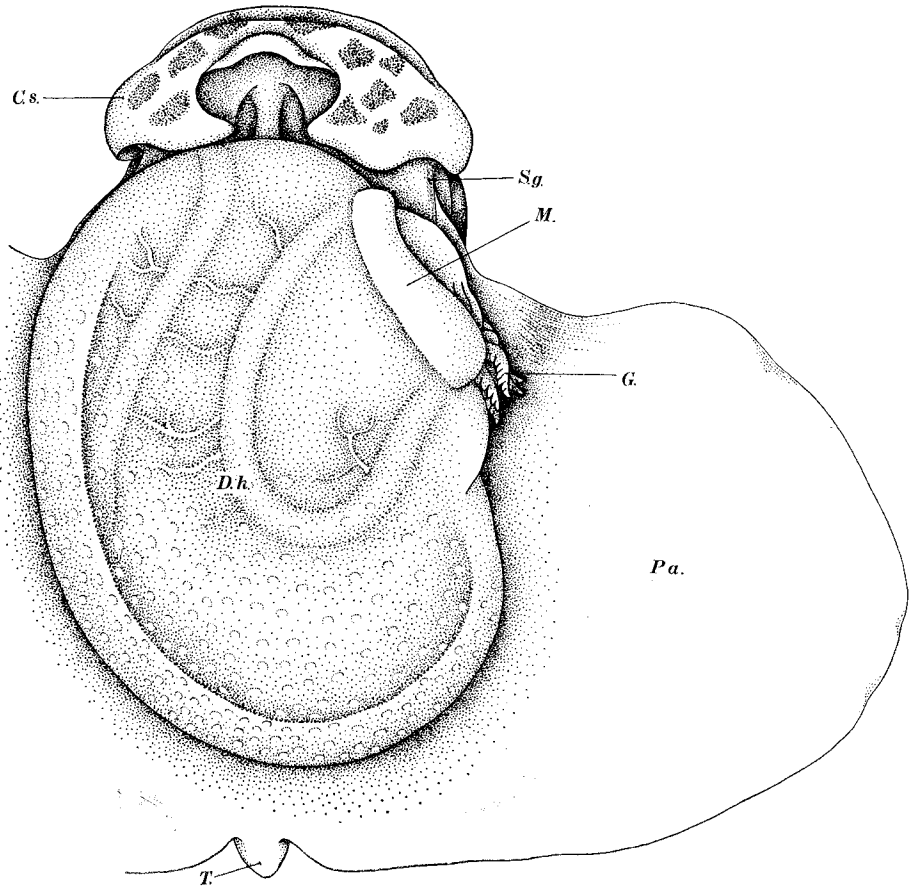


Fig. 2. *Gastropteron japonicum* n. sp. Dorsal side of holotype, left parapodium not shown, ×11.

borders. The tail is extremely short, it is a small triangular piece extending beyond the sole which is gently narrowed posteriorly and seemingly ends in a bifid tip (Text-fig. 3). The pedal gland (*P. g.*) is located near the posterior end of the sole and there is a short longitudinal groove (*Gr.*) between the gland aperture and the posterior end of the sole. About twenty-five strongly developed transverse muscles are seen across the sole in the holotype.

The free mantle margin is about one third as long as the dorsal hump and assumes a narrow flange overlying the ctenidium. No flagellum is found on the mantle. The ctenidium in the specimens examined bears thirteen leaflets and the distal part involving about six leaflets is entirely liberated. Each leaflet is an elongate triangular lamella stretched on the plane perpendicular to the rachis of the ctenidium, and is provided with about a dozen

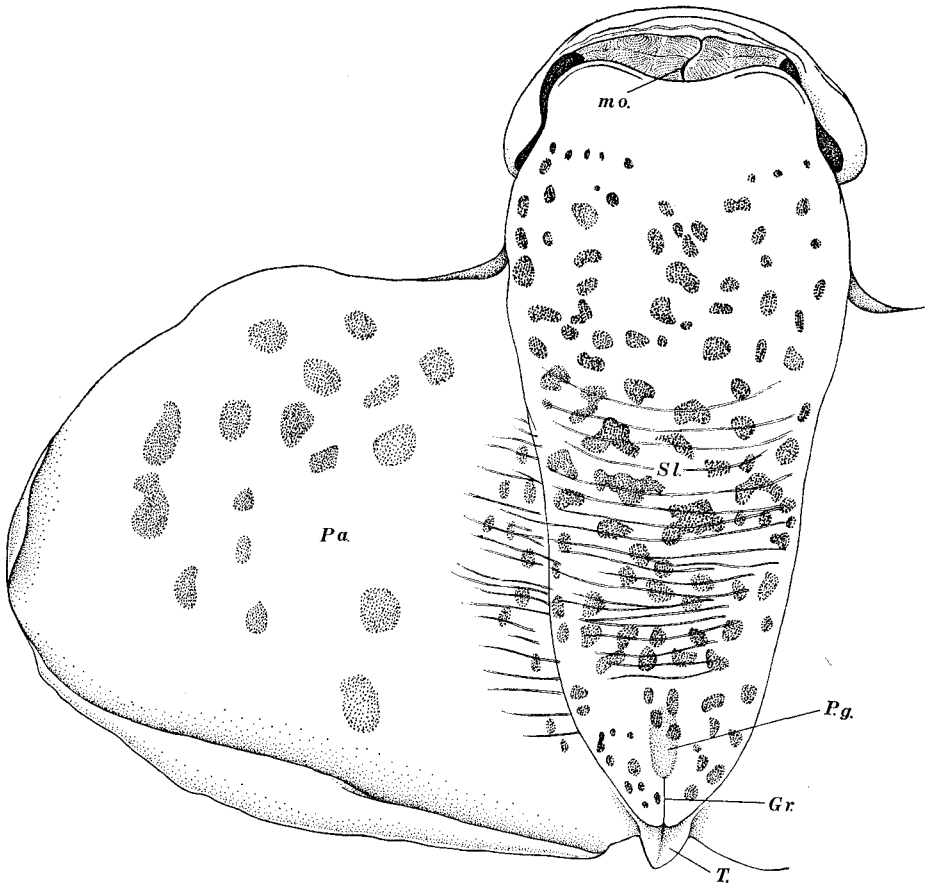


Fig. 3. *Gastropteron japonicum* n. sp. Ventral side of holotype, left parapodium not shown, ×11.

elevations on respective surface (Text-fig. 4 E). The ground membrane is rather narrow and thus the greater part of each leaflet is free. The anus lies behind the ctenidium and in some specimens it opens on a papilla. The nephridial aperture (Text-fig. 1, *Ne.*) is located a considerable distance dorsal to the anus. The hermaphrodite genital orifice (*H. g. o.*) is found just below the ctenidium at its base of liberation. The seminal groove is inconspicuous,

only the ventral edge of the groove is seen faintly. The male genital orifice (*m. g. o.*) is situated much posterior to the oral area. The mouth assumes a longitudinal slit (Text-fig. 4 D, *mo.*). The HANCOCK's organ consists of an anterior and a posterior portion; the former is pale yellowish, slightly depressed along the middle and wholly covered with fine curved striations,

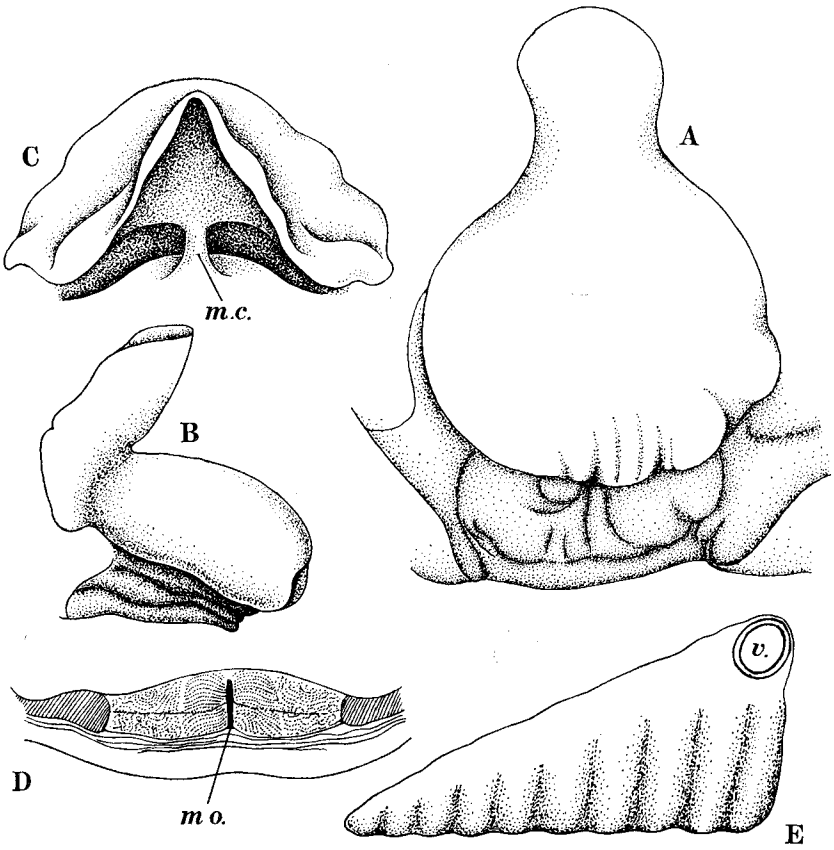


Fig. 4. *Gastropteron japonicum* n. sp. A, Paratype No. 1: cephalic shield, front view, ×15. B, Paratype No. 3: cephalic shield, right side. C, The same specimen: cephalic shield, apical view, ×15. D, Holotype: mouth area. E, Schematic representation of a ctenidium leaflet, lateral side; the right edge is attached to the ground membrane.

while the latter is yellowish brown and marked distinctly with oblique folds (Text-figs. 3, 4 D). The eyes are buried beneath the integument approximately at the level of the middle of the cephalic shield.

The shell could not be detected in any of the specimens by either dissecting or by making them translucent in carbowax solution. It is, however,

not impossible that the shell is very minute or of a perchment consistency, and devoid of any calcified portion, and thus it was overlooked by the authors. The mouth opening is guarded by a pair of jaw-plates. They are feeble, and tinged yellowish brown or pale yellow. Each plate, approximately triangular in shape, consists of closely packed, tiny rods. In the radular sac the ribbon of the radula is folded longitudinally and the whole organ may look like an elongate funnel. The teeth are faintly yellowish. There are no rachidian plates. The formulae in two specimens dissected are 19×5 (−6). 1. 0. 1. 5 (−6) (Paratype No. 1) and 20×5 (−6). 1. 0. 1. 5 (−6) (Paratype No. 2). The first lateral bears a series of 15–20 fine denticles on the inner edge of the main hook. The marginals are simply hamate, usually 5 and sometimes 6 in number.

The holotype and the paratype No. 1 were yollowish white throughout the body and sprinkled with reddish orange pigment flecks on the cephalic shield, especially in its anterior half, on the sole and also on narrow areas of the lower surface of parapodia along the sole. This colouration was much deeper on the sole, where the flecks were smaller but very much denser. The lower surface of parapodia was generally furnished with a little larger yellowish pigment flecks. The above-mentioned pigmentation was soon faded when the specimens were put into the dilute formalin solution to be observed under a strong illumination.

The colour sketch of live specimen of paratype No. 2 made by Mr. T. IKEBE of the Biological Laboratory of the Imperial Household (Pl. X fig. 9) shows that the animal was faintly yellowish in ground colour and the upper surface of each parapodium was sprinkled with small deep red pigment spots which tend to form three oval groups. The cephalic shield was orange as a whole and sprinkled with red pigment spots; the posterior end of the shield was fringed with a lilac border. The posterior half of the dorsal hump was purplish gray, probably due to the colouration of the viscera seen through the integument. This specimen was found wholly whitish in formalin, leaving no trace of any pigmentation. The paratype No. 3 was whitish and sprinkled with orange pigment flecks when alive.

Remarks: Evidently *G. japonicum* is related most closely to *G. pacificum* in that the free mantle margin is devoid of any flagellar appendage as seen in *G. rubrum* and *G. sibogae*. Points of agreement between *G. japonicum* and *G. pacificum* may also be found in the well defined sole with a short tail, and in the general colouration of live specimens, including the black pigmentation of the nephridial aperture. The types of the jaw-plates and radular teeth in *G. japonicum* do not differ materially from those in *G. pacificum* and *G. rubrum*— in *G. sibogae* at least, the first lateral is said to be nondenticulated. At first, we thought our specimens might be referred to *G. pacificum*. However, *G. pacificum* has 16–20 leaflets of ctenidium on individuals of nearly the same

body size as that of ours. As BERGH examined 13 specimens of his species, these numbers of ctenidium leaflets must be very exact. The holotype and two paratypes of *G. japonicum* have each only 13 ctenidium leaflets. The coincidence of the number of leaflets in our type series seems to enhance the significance of the difference in the number of the ctenidium leaflets between *G. pacificum* and *G. japonicum*. *G. sibogae* has 20 (−22) leaflets in 10–26 mm long specimens and thus it is separated from *G. japonicum* more distinctly, althorgh the colouration of live *G. sibogae* is not yet known. For these reasons, the present specimens from Sagami Bay are treated here as belonging to a new species, and named *japonicum*.

2. *Gastropteron flavum* n. sp.

(Japanese name : *Kiiro-umikotyô*)

(Text-figs. 5–7, Pl. X figs. 10–12, Pl. XI figs. 6–8, Pl. XIII fig. 3)

Holotype : Biological Laboratory of the Imperial Household, Sp. No. 745–B, collected from the shallow water of Sagami Bay around Kasazima off Sasima on March 24, 1951.

Paratypes : No. 1—Biological Laboratory of the Imperial Household, Sp. No. 745–A, collected together with the holotype.

No. 2—Biological Laboratory of the Imperial Household, Sp. No. 418, collected from the shallow water of Sagami Bay around Kasazima off Sasima on August 20, 1940.

No. 3—Biological Laboratory of the Imperial Household, Sp. No. 483, collected from the shallow water of Sagami Bay near Koiso of Hayama, on March 26, 1948.

In all four specimens were examined by the authors ; they are 2.5 mm to 5 mm in body length. Parapodium is large, the width is only a little less than the length of the dorsal hump in preserved specimens. The outline of the parapodium is parabolic, inclined anteriorly, and with the maximal breadth in the anterior half. The head region is not so much protruded out beyond the frontal level of parapodia. The dorsal hump is large, ovoid, much longer than wide. The surface is smooth. Each specimen bears a knob-like protuberance (*Kn.*) near the right posterior corner of the hump, approximately at the level of the posterior one-fourth. The cephalic shield is nearly as long as the dorsal hump, this is about a half of the body length in the holotype. Posteriorly it is gently narrowed. Lateral edges of the distal portion of the shield are somewhat incurled to form a kind of funnel. The constricted tip of the shield possibly points to the dorso-median crest which passes onto the inner surface of the shield. The sole is rather broad, with distinct borders, and the pore of the pedal gland opens at the level of the posterior one-third of it. There is a very distinct median longitudinal groove extending from the pore to near the tail end. The tail is large, not defined from the sole.

The free mantle margin is very short, its posterior end is near the level

of the anterior one-third of the dorsal hump. The ctenidium is very small, and nearly degenerated. Its form may be, as in the holotype (Text-fig. 7 A), a small tuft of four short, smoothly surfaced leaflets, each extending on the plane perpendicular to the rachis of the ctenidium in an elongate triangle; or, as in the paratype No. 1 (Text-fig. 7 B), a tongue-shaped protuberance bearing on it four rather irregularly shaped elevations; or merely, as in the

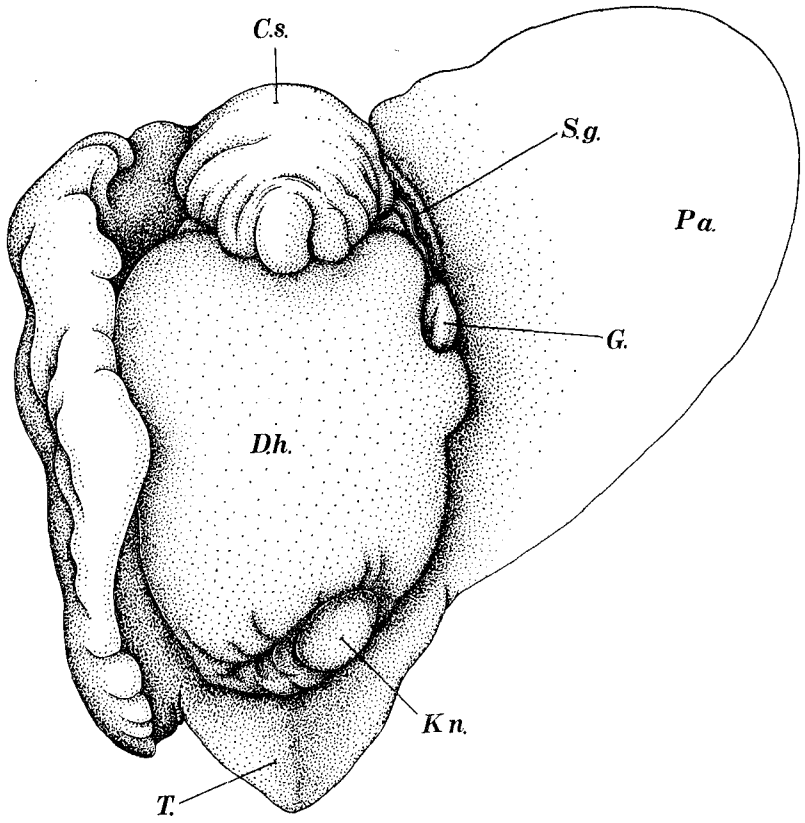


Fig. 5. *Gastropteron flavum* n. sp. Dorsal side of paratype No. 1, ×23.

paratype No. 2 (Text-fig. 7 C) which is the smallest of the specimens and 2.5 mm in body length, a small roundish protuberance. The anus opens behind the ctenidium, just inside the mantle margin. The hermaphrodite genital orifice is located immediately ventral to the attachment base of the ctenidium and usually covered by it. The seminal groove is usually very distinct; the ventral edge of the groove is undulated because of the strong contraction of the body, while the dorsal edge is kept nearly straight in all examined

specimens (Text-fig. 7 B, *S. g.*). The male genital orifice is open very near the mouth, but never held in it. In the paratype No. 2 only, the seminal groove is not yet formed (Text-fig. 7 C).

The shell could not be detected in any of examined specimens. The mouth part of the paratype No. 1 was examined. Presumably the jaw-plates are very feeble or almost rudimentary, and it was not easy to show them accurately here. The radular ribbon was exceedingly small, relative to the

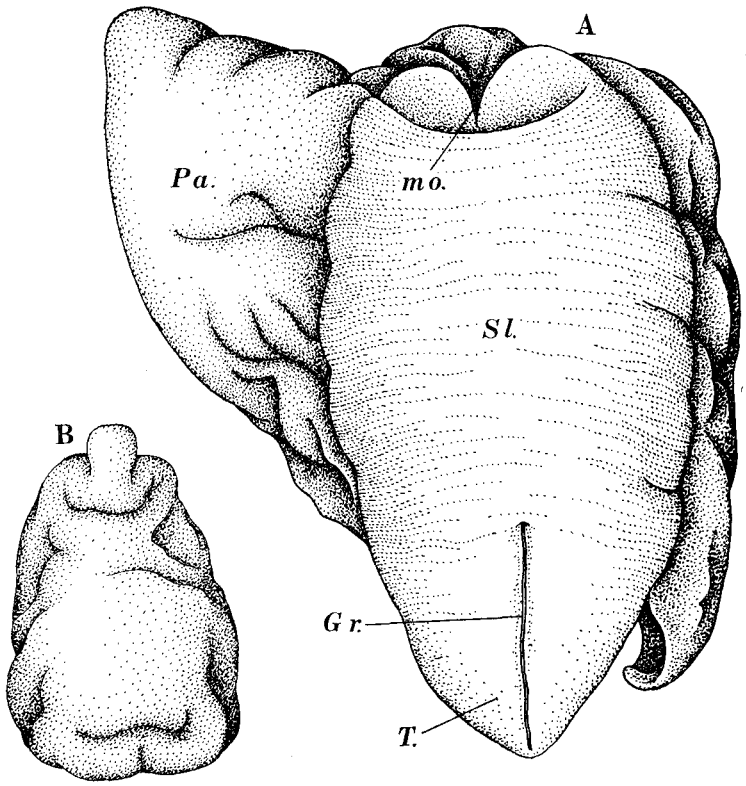


Fig. 6. *Gastropteron flavum* n. sp. Paratype No. 1. A, Ventral side, ×23. B, Cephalic shield, front view, ×23.

size of the animal. The formula 22×4. 1. 0. 1. 4; the teeth yellowish brown. The first lateral bears a series of about 12, rather irregular denticles. The marginals appear only 4 in number.

All the specimens preserved in alcohol are uniformly brownish. The colour sketches of live paratypes No. 2 and No. 3 show that these animals were coloured beautifully when they were alive; bright chrome yellow throughout the body, and minutely dotted with white. The posterior edge of

the cephalic shield is ivory black. The dorso-median crest is also ivory black, and this colour extends further down on each side. The knob-shaped protuberance which is represented in the colour sketches to be on the median line of the dorsal hump is coloured ivory black, too. The eyes are seen through the integument of the cephalic shield as paired dark points on live specimens.

Remarks: The characteristic colouration of live specimens and the existence of a single knob-like, or better mammillary in life according to colour sketches, protuberance situated near the right posterior corner of the dorsal hump in preservation, together with the short free mantle margin and degenerated ctenidium, are significant features separating the present speci-

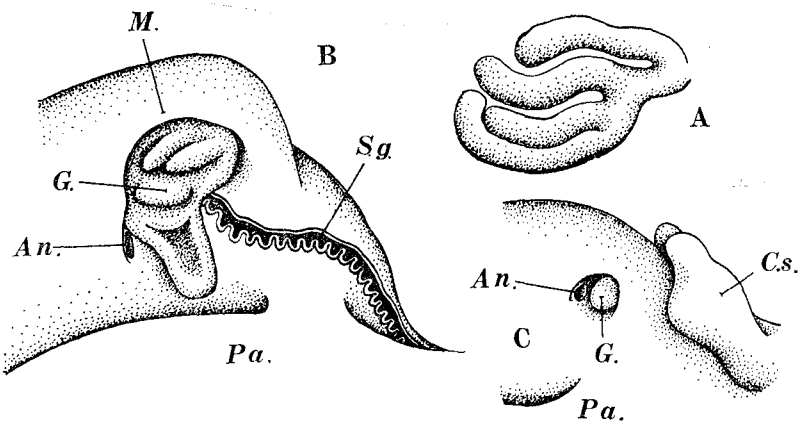


Fig. 7. *Gastropteron flavum* n. sp. Ctenidium, magnified. A, Holotype. B, Paratype No. 1. C, Paratype No. 2.

mens very easily from any hitherto known species of the genus. The new specific name, *flavum*, is thus suggested for them. The live animals crawl and at the same time swim very actively by flapping their parapodia. While swimming, the posterior portion of the dorsal hump is stretched posteriorly beyond the tail end (Pl. X fig. 12).

Additional specimens of this new species have been obtained from the Japan Sea side of Honsyû Island. The detailed informations are as follows:

(1) Four 2–3 mm long specimens on the shore of Hutao, Sado Island, collected by Mr. T. ABE of the Takaoka High School, Toyama Pref., on Aug. 5, 1954.

(2) Two 2 mm long specimens on the shore of Tozi in the vicinity of the Sado Marine Biological Station, Sado Island, collected by Dr. Y. HONMA of the Niigata University on July 16, 1955.

3. *Gastropteron viride* n. sp.

(Japanese name : *Midori-umikotyô*)

(Text-fig. 8, Pl. X fig. 8, Pl. XII figs. 1-3, Pl. XIII fig. 4)

Type: Biological Laboratory of the Imperial Household, Sp. No. 1035, collected at Kannon-tuka-dasi of Amadaiba in Sagami Bay, 70 m, on December 2, 1956.

Only a single 3.5 mm long specimen preserved in alcohol was available. The animal is contracted so strongly that the exact shape of parapodia can not be recognized. The head region does not protrude out beyond the level of the anterior edge of parapodia. The colour sketch (Pl. X fig. 8) of the live animal made by Mr. S. KATÔ of the Biological Laboratory of the Imperial Household shows that the animal is a little wider than long when both parapodia are extended and that each parapodium is nearly as wide as the dorsal hump and both lateral margins of parapodia are nearly straight. The head region does not protrude out even in the living state. On the preserved specimen, the dorsal hump is very large, oval in outline, longer than wide, and furnished on the surface with many longitudinal shallow grooves and low ridges which could not be judged whether they are natural. There is a short club-shaped protuberance (*Kn.*) on the median line at the posterior end of the hump. The cephalic shield is about half as long as the body in the contracted state. Towards the posterior end the lateral edges of the shield are incurved to form a sort of funnel; the extreme tip of the shield is constricted and protruded out. The sole is broad, with indistinct borders. The tail is not separated from the sole which appears to be markedly bifurcated posteriorly with a wide triangular cutting between the pair of tips. This state of bifurcation is quite unusual for species of *Gastropteron*. It is not impossible that this morphology is attributable to some injury, or misunderstanding of strongly contracted ends of parapodia. These questions must be cleared in future on more of specimens of better preservation. The exact situation of the pedal gland could not be ascertained. There is, however, a short longitudinal groove extending from the level of the posterior one-third of the sole to the bottom of the caudal incision. And, it is very likely that the pore of the pedal gland opens at the anterior end of this longitudinal groove.

The free mantle margin is extremely long, being stretched from near the right anterior corner of the dorsal hump to the posterior median protuberance and forms a narrow flange. There is found an orifice (Text-fig. 8C, *M. p.*) below the posterior median protuberance of the hump, but it is not known whether this is nothing but a scar of some injury or a natural mantle sperture. The ctenidium is small, though well developed. It consists of eight leaflets, of which the distal three are larger than the proximal five. They are not

plumaged. The anus opens on a small papilla located just behind the ctenidium. The hermaphrodite genital orifice (*H. g. o.*) is found near the anterior end of the ctenidium base. The seminal groove is defined, but not distinctly. The mouth is represented by a longitudinal slit.

The shell could not be detected by either dissection or by making the

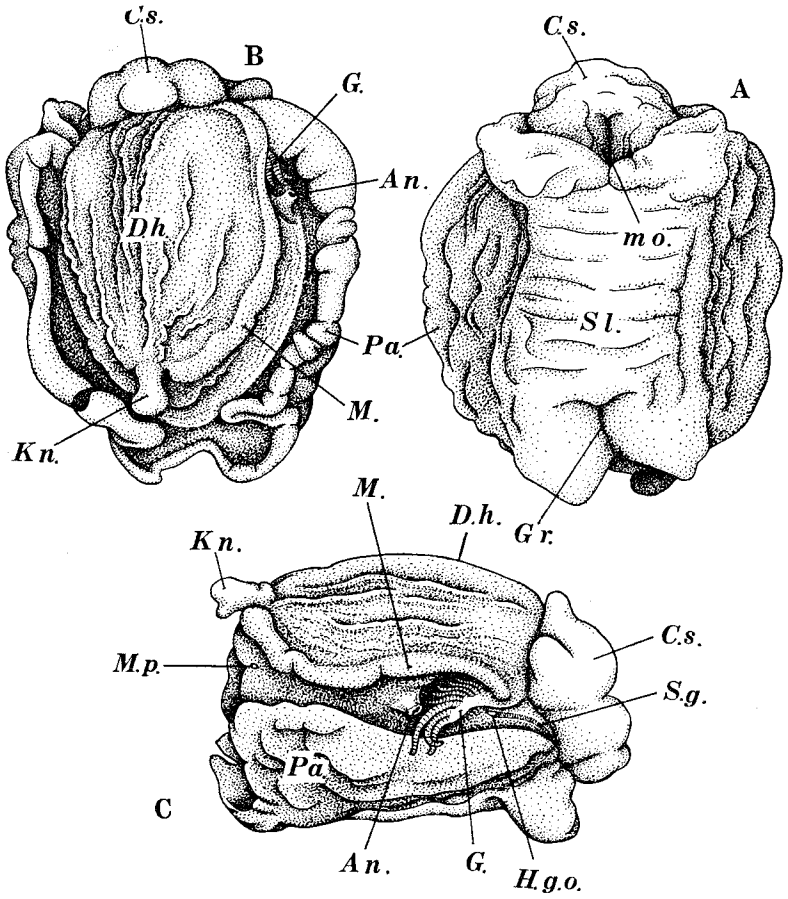


Fig. 8. *Gastropteron viride* n. sp. Type specimen, ×15. A, Ventral side. B, Dorsal side. C, Right side.

specimen translucent in carbowax solution. No mention is possible for the jaw-plates; they were presumed to be very feeble. Radular formula 18 (?)× 4. 1. 0. 1. 4. The radular ribbon is decidedly small, and the teeth are slightly yellowish. The first lateral is provided with a series of about 10 denticles. The marginals are simple and counted to be 4 for each half-row.

The preserved specimen is uniformly dark brownish, although the live

specimen was coloured very beautifully. According to Mr. KATÔ's sketch, the upper surface of the parapodia is greenish and fringed with a white margin. There are two bright red patches along the periphery of each parapodium, the anterior one situated near the middle is larger than the posterior located close to the posterior end of the parapodium. The dorsal hump is yellowish, with a white patch near the centre and a large red patch slightly posterior to it; the posterior median protuberance is coloured red. The cephalic shield is yellowish and bears a red colour pattern of Lorraine Cross near the posterior edge. The median line of the head region is painted whitish. The specimen is accompanied with about 750 eggs which were laid by the animal while it was observed for drawing. These eggs are 180–210μ in diameter and according to an annexed note they were coloured reddish orange and packed in irregular masses in the colourless and transparent gelatinous substance (Text-fig. 14 B).

Remarks: Apart from the doubtful feature of the bifurcated tail and the questionable existence of the mantle aperture, the exceedingly long mantle margin, the possession of a club-shaped protuberance at the posterior end of the dorsal hump, and the body colours in life seem to be enough to characterize the present specimen as the type of a new species. The specific name, *viride*, is given for the sake of the general greenish colour of the parapodia.

Sagaminopteron n. g.

Radular formula 9–12. 1. 0. 1. 9–12. The first lateral is provided with two prominent cusps on the inner edge of the main hook; the marginals are greatly large in number. Type: *S. ornatum* n. sp.

This new genus is separated from *Gastropteron* which has the radular formula 4–6. 1. 0. 1. 4–6, and in which the first lateral bears a series of fine denticles on the inner edge of the main hook.

4. *Sagaminopteron ornatum* n. sp.

(Japanese name: *Murasaki-umikotyô*)

(Text-figs. 9–14, Pl. X figs. 1–7, Pl. XII figs. 4–8, Pl. XIII figs. 5–6)

Holotype: Biological Laboratory of the Imperial Household, Sp. No. 419, collected at Miyosenotakane of Kameki-syo in Sagami Bay, 13 m, on August 2, 1940.

Paratype: A single specimen collected at the rocky shore around Tôsima near the Seto Marine Biological Laboratory by Mr. T. YAMAMOTO on June 1, 1958.

The holotype is 8.7 mm long in the preserved state in alcohol, and the paratype was 12 mm long when alive. On the holotype, the parapodia are comparatively narrow, nearly as wide as the dorsal hump and widest in the

anterior half, while the tail is very large and the head region does not protrude out beyond the frontal level of parapodia. Thus the whole body assumes roughly an inverted triangle when the parapodia are fully extended (Text-fig. 10, Pl. X fig. 2). The dorsal hump is ovoid and furnished on the posterior half with two pairs of protuberances of which the anterior pair (1 and 2) are much larger than the posterior pair (3 and 4). The left anterior protuberance (2) is bifid and this may be regarded as two protuberances fused together. The right anterior one (1) is the largest of all and forms itself the posterior

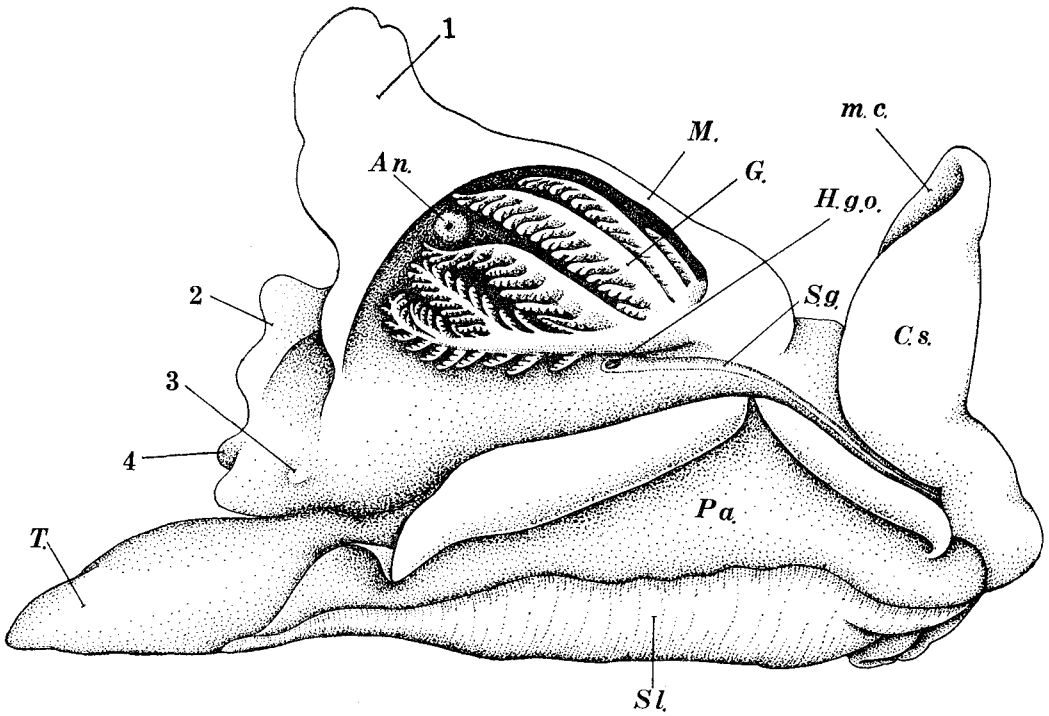


Fig. 9. *Sagaminopteron ornatum* n. g., n. sp. Right side of holotype, ×15. 1, 2…Pair of anterior larger protuberances. 3, 4…Pair of posterior smaller protuberances.

part of the free mantle margin; in situation this is very similar to the flagellar appendage found in *G. rubrum* (Text-fig. 9). The protuberances of the posterior pair are simply conical. According to the colour sketches of the holotype, there appear four small prominences between the right and left anterior protuberances (1 and 2), and three prominences in front of the left anterior protuberance (2). It is clear that the posterior pair of small protuberances (3 and 4) correspond to two of these small prominences, although it is impossible to determine which of those prominences are left on the

preserved specimen as small protuberances. On the paratype, in the living state, the right anterior protuberance (1) was much larger than the left anterior one (2). The posterior pair of protuberances were merely conical,

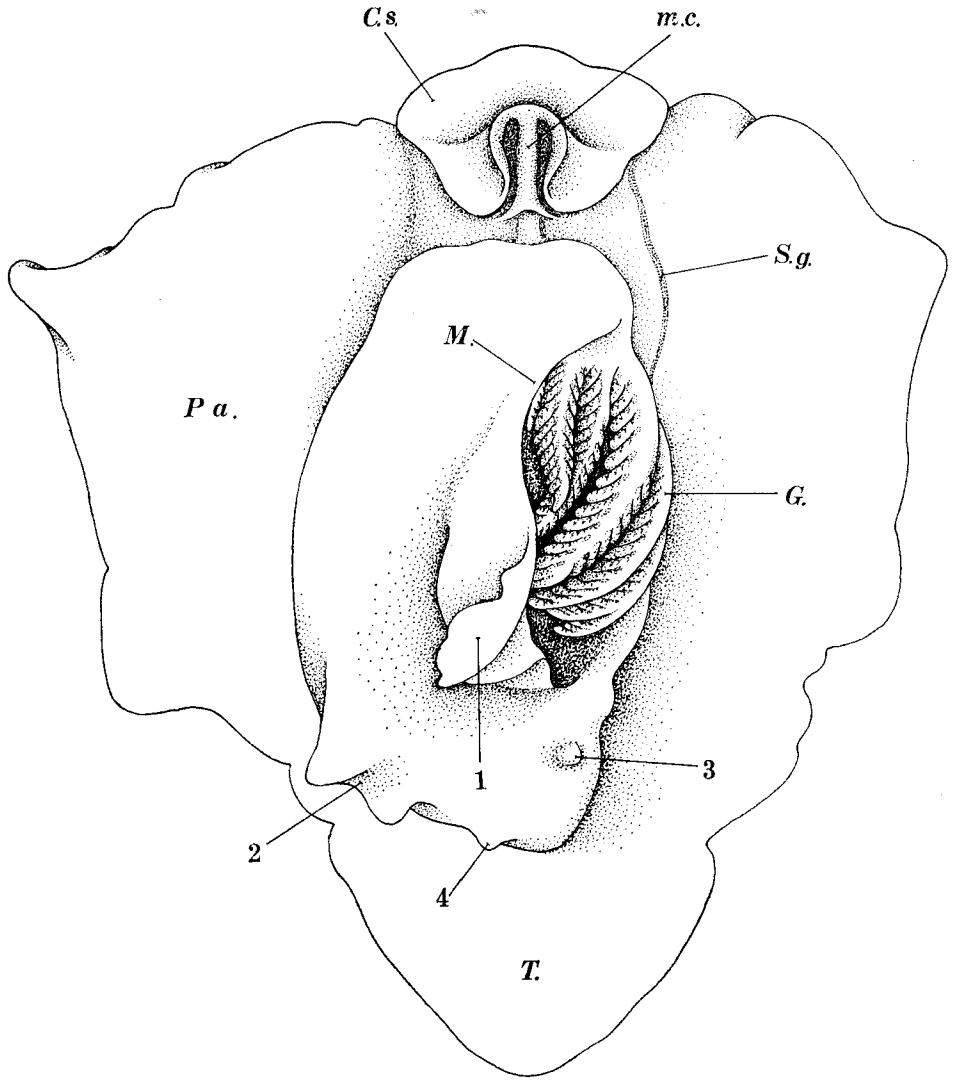


Fig. 10. *Sagaminopteron ornatum* n. g., n. sp. Dorsal side of holotype, ×15. 1, 2···Pair of anterior larger protuberances. 3, 4···Pair of posterior smaller protuberances.

and there was another small protuberance between the right anterior (1) and posterior (3) protuberances (Text-fig. 13 B). In both of the holotype and paratype, the cephalic shield is elongate, a little shorter than one half of the body

length. Antero-laterally it develops a pair of short cephalic tentacles (*C. t.*) which can be seen clearly in the living state. Posteriorly the lateral edges are incurled to form a sort of funnel. The dorso-median crest extends onto

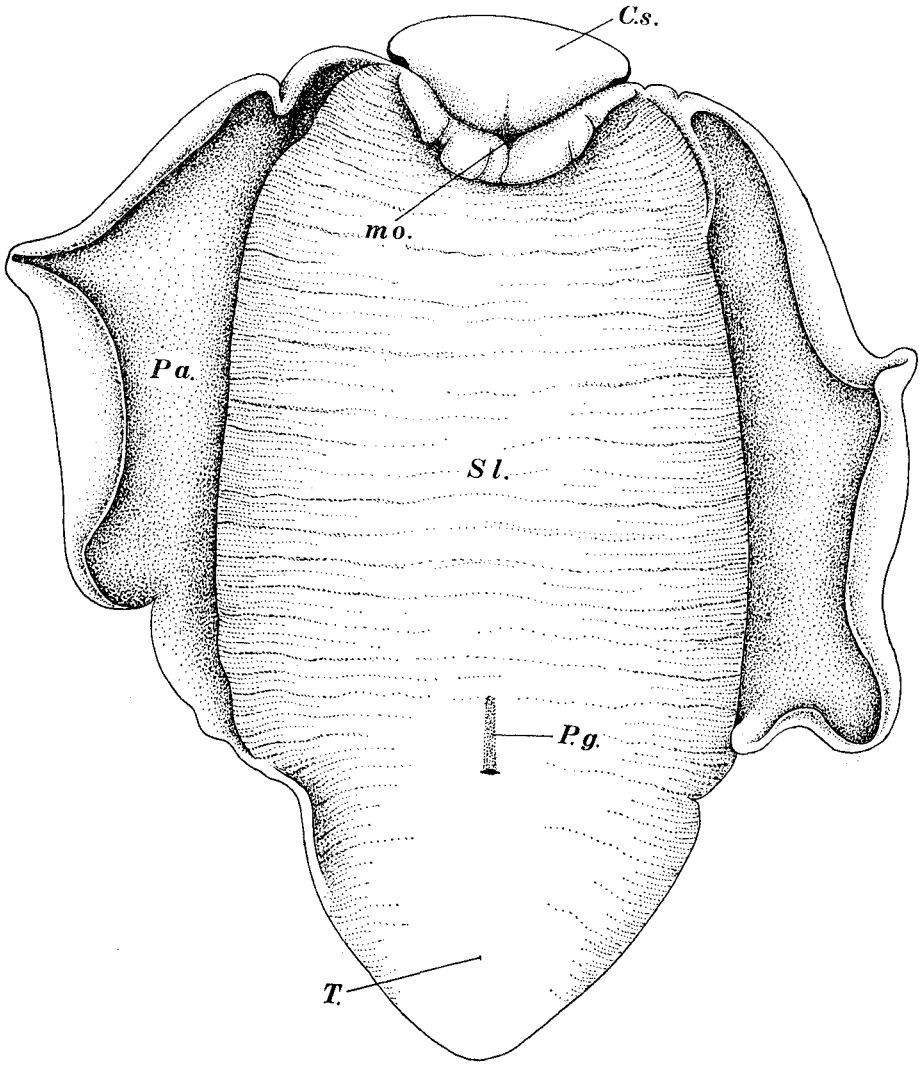


Fig. 11. *Sagaminopteron ornatum* n. g., n. sp. Ventral side of holotype, ×15.

the inner surface of the shield up to its tip, being embraced within the funnel. The sole is broad and with distinct borders. The tail is not separated from the sole, and on the dorsal view of the animal it is extended far posteriorly beyond the posterior end of the dorsal hump (Text-fig. 10). The pore

of the pedal gland opens approximately at the level of the posterior edge of the parapodia and the gland itself is 0.6–0.7 mm long (Text-fig. 11).

The free mantle margin mentioned above is very long, about three fourths as long as the dorsal hump. The ctenidium is very large and quite liberated (Text-fig. 9). It bears seven plumaged leaflets along the dorsal edge of the rachis, those increase in size from the distal towards the proximal, except for the most proximal one that is much smaller than the followings. Larger leaflets have respectively up to 14 short branches on each side. Along the ventral edge of the rachis, there are 15–20 pinnae, some proximal ones of which are then provided each with a few pinnules. The anus opens on a papilla situated postero-dorsal to the ctenidium. The hermaphrodite genital orifice lies a little posterior to the base of the ctenidium. The seminal groove is distinct. The male genital orifice is located near the mouth.

The shell could not be detected by either dissection or making the specimen translucent in carbowax solution. It is presumed here also that

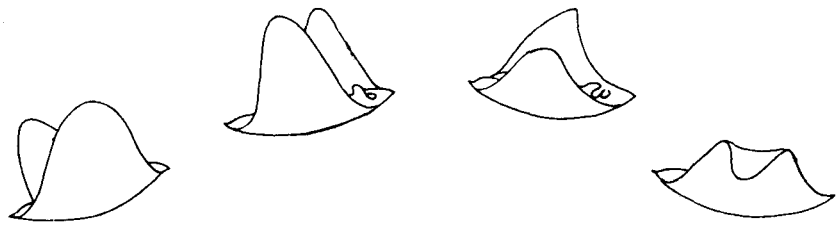


Fig. 12. *Sagaminopteron ornatum* n. g., n. sp. Animal in swimming. (H. SANADA del.)

jaw-plates are very feeble and rudimentary; these were not recognized clearly in either of the holotype and paratype. The radular formula of the holotype is 27×9–12. 1. 0. 1. 9–12 and that of the paratype is 25×9–10. 1. 0. 1. 9–10. It is to be noticed that in this new species the marginals are much more numerous than in usual species of *Gastropteron*. Also the first lateral is very distinguished by the possession of two prominent cusps on the inner edge of the main hook.

The holotype preserved in alcohol is brownish flesh throughout, while it is represented in colour sketches to be generally iridescent reddish purple in the living state. The free mantle margin is whitish and fringed with an orange border, and this colouration continues posteriorly to a loop of the same colouration covering all protuberances found on the posterior half of the dorsal hump. All these protuberances, both the larger and smaller ones, are coloured orange. The posterior margin of the cephalic shield and the inner surface of the shield are orange yellow. The dorso-median crest is

orange yellow, too, excepting its middle portion which is coloured white in the anterior and purplish in the posterior half. The ctenidium is whitish. On the paratype, the posterior margin of the cephalic shield, the dorso-median crest and the various protuberances on the posterior half of the dorsal hump are all coloured chrome yellow. The general body colour is rosy purple. The eyes are seen as a pair of dark points buried beneath the integument

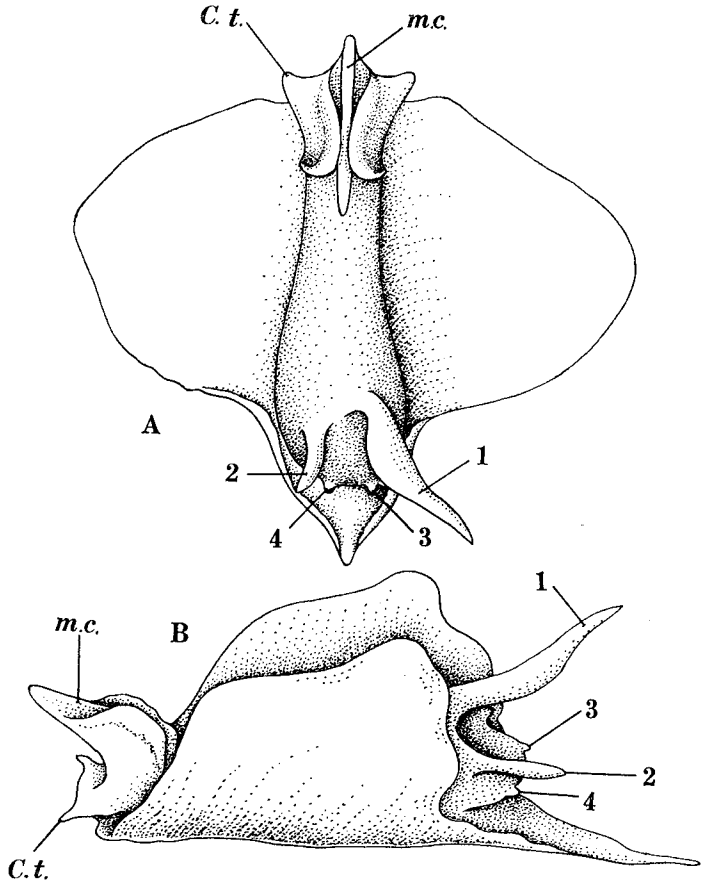


Fig. 13. *Sagaminopteron ornatum* n. g., n. sp. A, 12 mm long live specimen from Tôsima near S. M. B. L. (paratype) B, in creeping. (K. BABA del.) 1, 2···Pair of anterior larger protuberances. 3, 4···Pair of posterior smaller protuberances.

of the cephalic shield.

The animals are known to swim actively by flapping parapodia (Text-fig. 12). The paratype laid an egg mass while it was kept alive in an aquarium. The mass (Text-fig. 14 A) is flattened, gelatinous, about 6 mm across and found attached to the substratum by an end. The eggs are 170–180μ in diameter and milky white.

Remarks: In the external aspects, the present new species may easily be distinguished from any of the hitherto known species of the family Gastropteridae by having several additional protuberances besides a very prominent one formed by prolongation of the posterior part of the free mantle margin, and by its unique colouration. The specific name *ornatum* is due to the remarkable features afforded by various protuberances and colours.

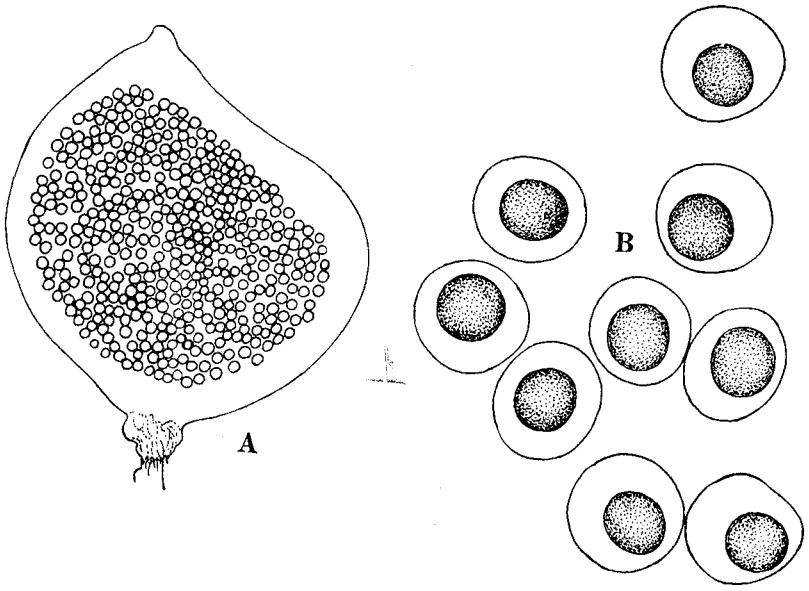


Fig. 14. A, *Sagaminopteron ornatum* n. g., n. sp. Egg mass laid by paratype from Tôsima near S. M. B. L. (K. Baba del.), ×7. B, *Gastropteron viride* n. sp. Eggs liberated by holotype, ×73.

Abbreviations

An. ·····anus
C. s.·····cephalic shield
C. t.·····cephalic tentacle
D. h.·····dorsal hump
G.·····ctenidium
Gr. ·····groove
H. g. o. ···hermaphrodite genital orifice
Kn. ·····knob
M. ·····free mantle margin
m. c.·····dorso-median crest of head region
m. g. o. ···male genital orifice
mo. ·····mouth
M. p. ·····? mantle aperture
Ne. ·····nephridial aperture
Pa. ·····parapodium
P. g.·····pedal gland
S. g.·····seminal groove
Sl. ·····sole
T.·····tail
V. ·····vessel through the rachis of ctenidium

REFERENCES

ABBOTT, R. T. (1955) : American Seashells. Third edition. D. Van Nostrand Co., pp. 283–285, text-fig. 60–e.

ADAMS, A. (1861) : On some new species of Mollusca from the north of China and Japan. Ann. Mag. Nat. Hist., Ser. 3, Vol. 8.

BERGH, R. (1893) : Die Gattung *Gastropteron*. Zool. Jahrb., Abt. Anatomie u. Ontogenie, Vol. 7, Part 2, pp. 281–308, pls. 16–17.

———— (1894) : Die Opisthobranchien. Bull. Mus. Comp. Zool. Harvard Coll., Vol. 25, No. 10, pp. 202–205, Pl. 12, 2 text-figs.

———— (1905) : Die Opisthobranchiata der Siboga-Expedition. Siboga-Exped., Monogr. 50.

BINNEY, W. G. and TRYON, G. M. (1864) : The complete writings of CONSTANTINE SMALTZ RAFINESQUE on recent and fossil Conchology.

DALL, W. H. (1921) : Summary of the marine shellbearing mollusks of the northwest coast of America, from San Diego, California, to the Polar Sea, mostly contained in the collection of the United States National Museum, with illustrations of hitherto unfigured species. U. S. Nat. Mus. Bull. 112, 217 pp., 22 pls.

———— (1925) : The Pteropoda collected by the Canadian Arctic Expedition 1913–18, with description of a new species from the North Pacific. Canadian Arctic Expedition 1913–18, Vol. 8, Part B, pp. 9–12, Text-fig. 4.

FISCHER, P. (1890) : Observations sur la synonymie et l'habitat du *Gastropteron rubrum* RAFINESQUE. Jour. d. Conchyl., Vol. 38, pp. 349–353.

FRANC, A. (1948) : Véligères et mollusques gastéropodes des baies d'Alger et de Banyuls. Jour. d. Conchyl., Vol. 83, pp. 13–35, 2 pls.

GUIART, J. (1901) : Contribution a l'étude des gastéropodes opisthobranches et en particulier des céphalaspides. Mém. Soc. Zool. Fr., Vol. 14, 219 pp., 7 pls.

HOFFMANN, H. (1932–40) : Opisthobranchia in : BRONN's Klassen und Ordnungen des Tierreichs. Leipzig.

LEMCHE, H. (1956) : The anatomy and histology of *Cylichna* (Gastropoda Tectibranchia). Spolia Zool. Mus. Hauniensis, Vol. 16, pp. 1–278, 46 pls.

MARCUS, Ev. and MARCUS, Er. (1960) : Opisthobranchs from American Atlantic warm waters. Bull. Mar. Sci. Gulf and Carib., Vol. 10, No. 2, pp. 129–203, 97 text-figs.

MORTON, J. E. and HOLME, N. A. (1955) : The occurrence at Plymouth of the opisthobranch *Akera bullata*, with notes on its habits and relationships. J. mar. biol. Ass. U. K., Vol. 34, pp. 101–112, 1 pl., 2 text-figs.

OLDROYD, I. Sh. (1927) : The marine shells of the west coast of North America. Vol. 2, Part 1, pp. 45–46.

PILSBRY, H. A. (1895–6) : Manual of Conchology. Vol. 16, pp. 39–43 and 239.

PRUVOT-FOL, A. (1954) : Mollusques opisthobranches. Faune de France, 58.

THIELE, J. (1931) : Handbuch der systematischen Weichtierkunde. Part 2, pp. 393–394.

THOMPSON, T. E. and SLINN, D. J. (1959) : On the biology of the opisthobranch *Pleurobranchus membranaceus*. J. mar. biol. Ass. U. K., Vol. 38, pp. 507–524, 1 pl., 8 text-figs.

VAYSSIÈRE, A. (1885) : Recherches zoologiques et anatomiques sur les mollusques opisthobranches du Golfe de Marseille. Ann. Mus. d'hist. nat. Marseille, Zool., Vol. 2, pp. 40–43, Pl. 2, figs. 35–41.

Postscript: Another specimen of *Gastropteron japonicum* was collected by His Majesty at Kannontuka-dasi of Amadaiba in Sagami Bay, 70–90 m, on July 14, 1964 and sent to the authors for examination. The animal preserved in alcohol is 5.3 mm long; each parapodium, 3.6 mm in width, is considerably wider than the dorsal hump that is 2.6 mm wide at the maximum. Morphologically this specimen conforms exactly to the specimens previously described. The colouration resembles closely that of the paratype No. 2. The body is whitish throughout; parapodia are generally dotted with minute purplish brown pigment spots on respective surfaces, but the periphery, especially on the under surface, is dotted with orange spots. The sole is also densely dotted with orange spots. The cephalic shield is dotted with purplish brown

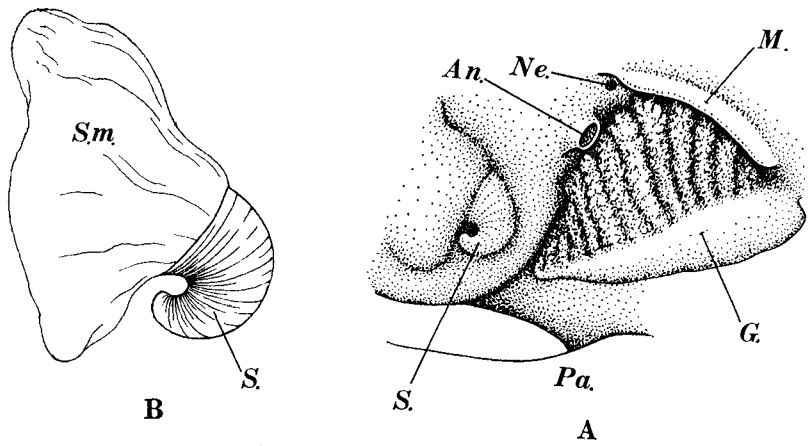


Fig. 15. *Gastropteron japonicum* n. sp. Biological Laboratory of the Imperial Household Sp. No. 1229. A, Embryonal shell (*S.*) *in situ*, ×25. B, The same magnified, *S. m.* shows a membranous structure attached to the embryonal shell.

spots except for the anterior margin which is sprinkled with orange spots. The posterior half of the HANCOCK's organ is marked with reddish orange flecks. The dorsal hump is translucent, yellowish white and dotted with purplish brown spots. The tail is entirely devoid of any pigmentation on the under surface. The nephridial aperture is dark coloured.

The ctenidium is contracted so strongly that the exact number of leaflets can not be found out. The seminal groove is very faint. The embryonic shell is found postero-ventral to the anus. It is horn-shaped, strongly curved and 430μ in length (Text-fig. 15 S.). It is calcified, but hyaline and very fragile as the embryonic shells generally found in gastropod veligers are. A much larger membranous appendage (*S. m.*) is attached to the edge of the

shell, although the exact outline of this appendage is not clear as it is much softened.

The live animal was found mostly in crawling, but seldom in active swimming. The specimen is kept at the Biological Laboratory of the Imperial Household, Sp. No. 1229.

EXPLANATION OF PLATES X-XIII

PLATE X.

Figs. 1–7. *Sagaminopteron ornatum* n. g., n. sp., living holotype. (Mr. H. SANADA del.)
1. Dorsal side.
2. Dorsal side, with parapodia extended.
3. Right side.
4. Ventral side of the creeping animal.
5. Tip of the cephalic shield.
6, 7. Protuberances on the dorsal hump and the ctenidium.

Fig. 8. *Gastropteron viride* n. sp., living type laying eggs, dorsal. (Mr. S. KATO del.)

Fig. 9. *Gastropteron japonicum* n. sp., living paratype No. 2, dorsal. (Mr. T. IKEBE del.)

Figs. 10–12. *Gastropteron flavum* n. sp., living paratype No. 2. (Mr. H. SANADA del.)
10. Dorsal side.
11. Dorsal side, with parapodia extended.
12. Left side of the swimming animal with flapping parapodia.

(The scale is 6/7 of the natural size for each species.)

PLATE XI.

Fig. 1. *Gastropteron japonicum* n. sp., preserved holotype, dorsal side. (×3.5)

Figs. 2–3. *Gastropteron japonicum* n. sp., paratype No. 1.
2. Entire radular ribbon from above. (×25)
3. Details of the lateral teeth in the proximal (new) end of the radular ribbon. (×50)

Figs. 4–5. *Gastropteron japonicum* n. sp., paratype No. 2.
4. Preserved animal, dorsal side. (×4.3)
5. Paired jaw-plates. (×45)

Fig. 6. *Gastropteron flavum* n. sp., preserved holotype, dorsal side. (×4.7)

Figs. 7–8. *Gastropteron flavum* n. sp., paratype No. 1.
7. Preserved animal, dorsal side. (×4.7)

8. Part of the radular ribbon, showing details of the lateral teeth taken from the left half of the ribbon. (×300)

PLATE XII.

Figs. 1–3. *Gastropteron viride* n. sp., type.
1. Proximal half of the radular ribbon from above. (×120)
2. Details of the lateral teeth. (×235)
3. Details of some of the isolated lateral teeth. (×230)

Figs. 4–6. *Sagaminopteron ornatum* n. g., n. sp., holotype.
4. Preserved animal, dorsal side. (×4)
5. Entire radular ribbon from above. (×40)
6. Details of the lateral teeth in the proximal end of the ribbon. (×80)

Figs. 7–8. *Sagaminopteron ornatum* n. g., n. sp., paratype.
7. Entire radular ribbon from above. (×25)
8. Details of the lateral teeth in the distal (old) end of the ribbon. (×50)

PLATE XIII.

Fig. 1. *Gastropteron japonicum* n. sp., paratype No. 1.
A. Paired jaw-plates. (×30)
B. Elements of the jaw-plate. (×130)
C. A row of lateral teeth in the proximal end of the radular ribbon. (×70)

Fig. 2. *Gastropteron japonicum* n. sp., paratype No. 2.
A. Front view of the pharynx.
B. Elements of the jaw-plate. (×50)
C. A row of lateral teeth in the distal end of the radular ribbon. (×70)
D. A row of lateral teeth in the proximal end of the radular ribbon. (×70)

Fig. 3. *Gastropteron flavum* n. sp., paratype No. 1, a left half-row of lateral teeth near the proximal end of the radular ribbon. (×100)

Fig. 4. *Gastropteron viride* n. sp., type.
A. A row of lateral teeth in about the mid-length of the radular ribbon. (×400)
B. Some of the isolated lateral teeth. (×270)

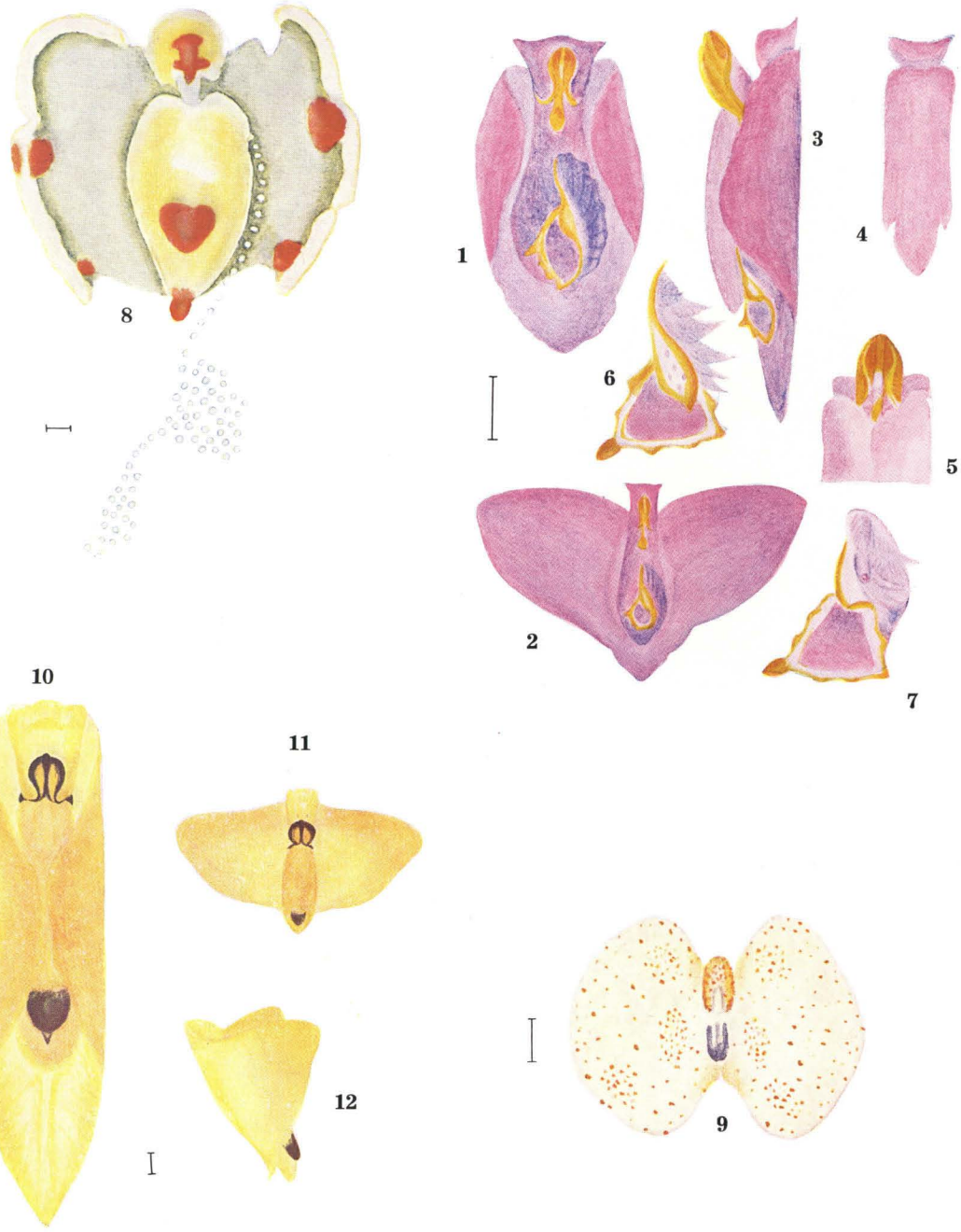
Fig. 5. *Sagaminopteron ornatum* n. g., n. sp., holotype.
A. A row of lateral teeth in the distal end of the radular ribbon. (×130)

B. A row of lateral teeth in the proximal end of the radular ribbon. (×130)

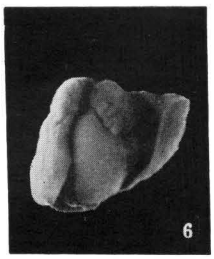
Fig. 6. *Sagaminopteron ornatum* n. g., n. sp., paratype, a right half-row of lateral teeth in the proximal end of the radular ribbon. (×130)

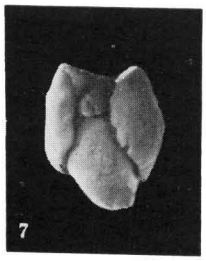
Captions used in PLATE XIII:

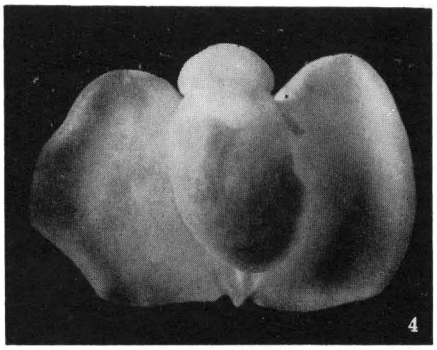
a.……mouth opening
b.……jaw-plates
c.……first lateral
d.……marginals
e.……main hook of the first lateral
f.……denticles on the inner edge of the first lateral
g.……cusps on the inner edge of the first lateral

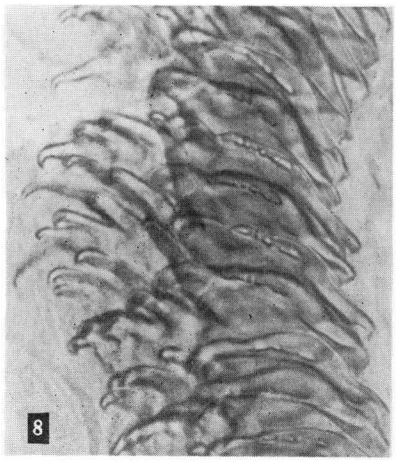


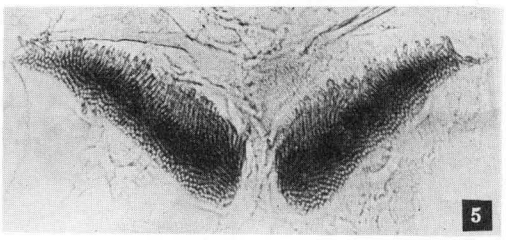
TOKIOKA AND BABA: NEW SPECIES AND GENUS OF GASTROPTERIDAE.

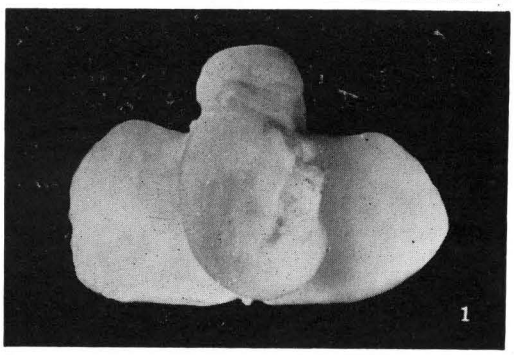


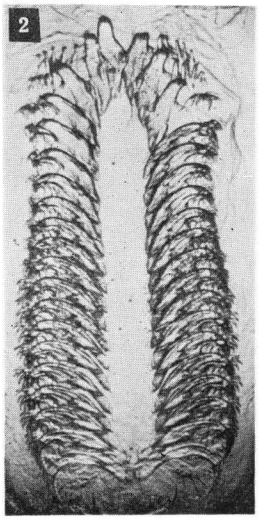


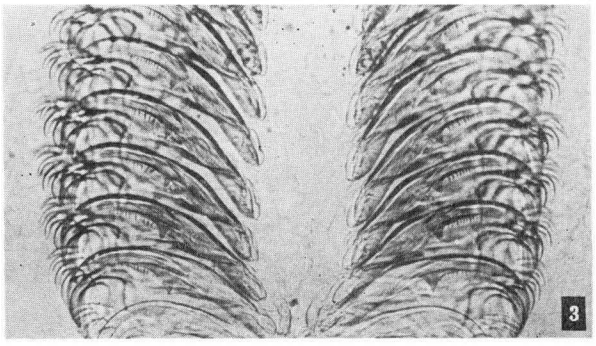




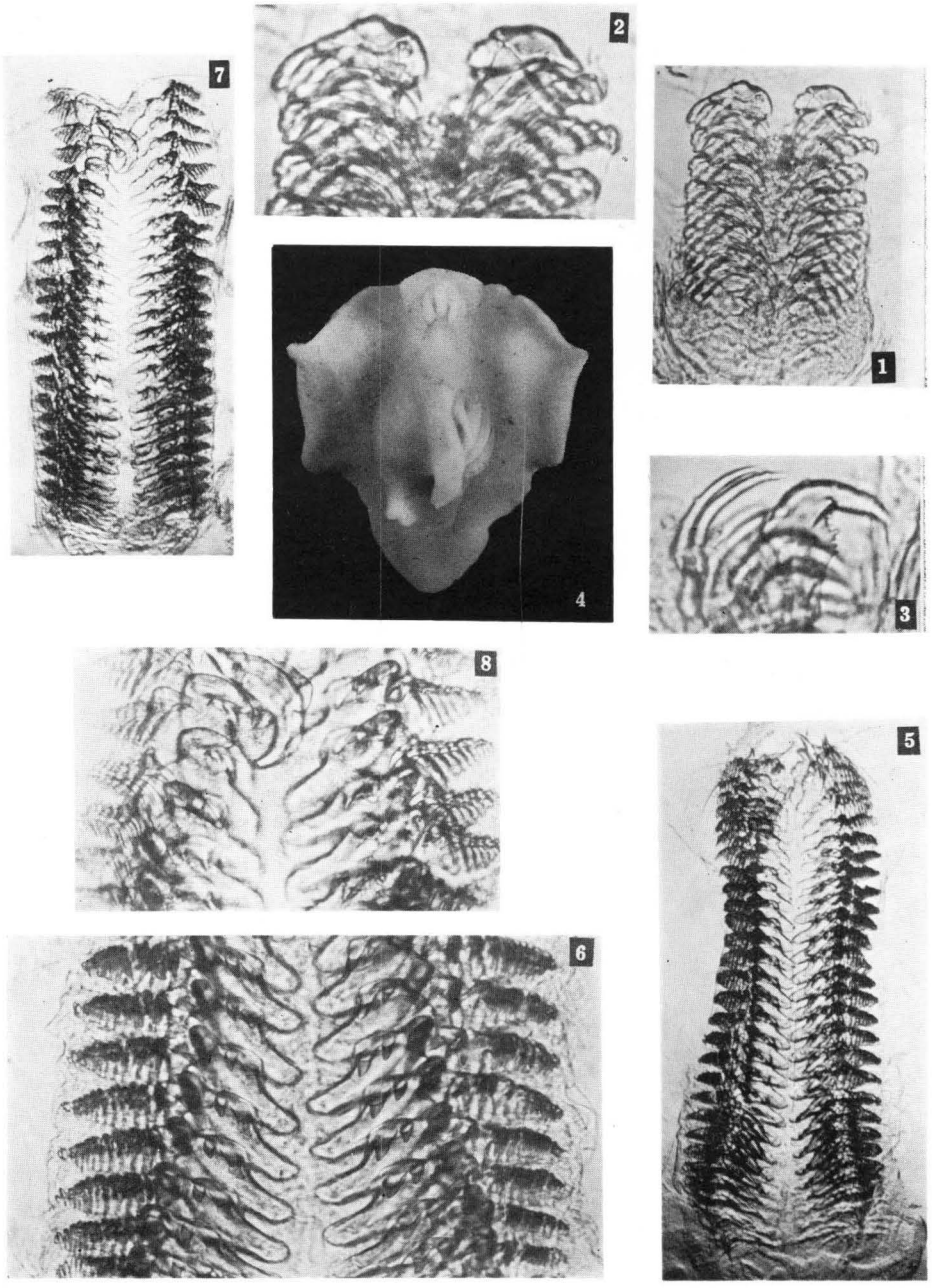




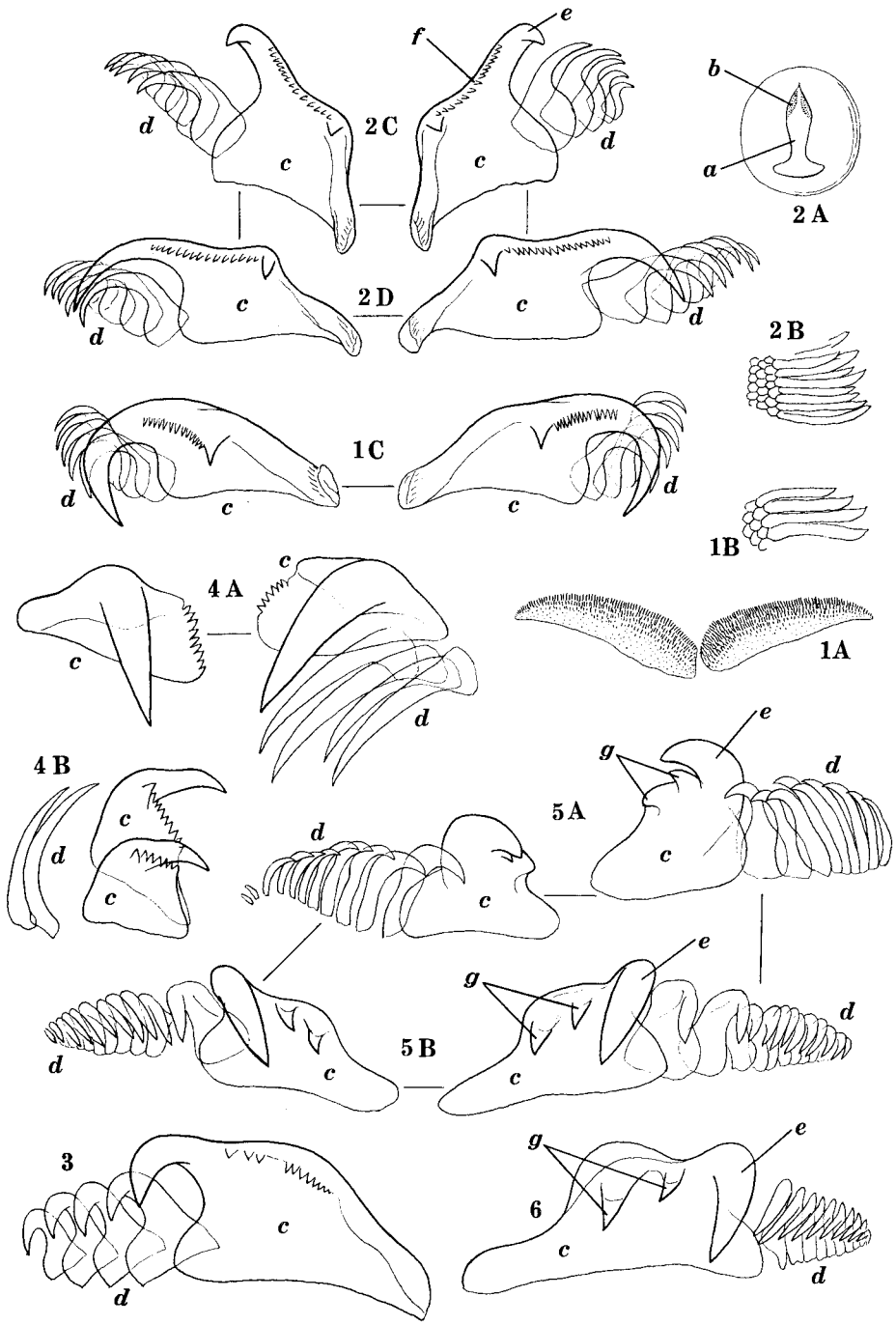




TOKIOKA AND BABA : NEW SPECIES AND GENUS OF GASTROPTERIDAE.



TOKIOKA AND BABA: NEW SPECIES AND GENUS OF GASTROPTERIDAE.



TOKIOKA AND BABA : NEW SPECIES AND GENUS OF GASTROPTERIDAE.